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WALTER M. DICKIE, M.D., Director

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Air Conditioning, A Phase of Industrial Hygiene

By Earl W. Daken, Engineer, Industrial Hygience Service, California State Department of Public Health

A recent article in this bulletin outlining the role of the engineer in the industrial hygiene program states: "Industrial hygiene is concerned with the protection of health, the promotion of efficiency, and the prolongation of life of industrial workers." Based on this definition, especially "the promotion of efficiency," air conditioning must be included as a major part of a comprehensive industrial hygiene program.

Air conditioning, in its broadest sense, implies control of any or all of the physical and chemical qualities of air. More particularly, it includes the simultaneous control of temperature, humidity, movement, and purity of air.

Contrary to general opinion, we are not particularly concerned with the changes in oxygen and carbon dioxide content of the air due to respiratory processes, because ordinarily, they are much too small to be of any physiological significance.

More important that the oxygen or carbon dioxide content of the room is the odoriferous organic matter arising from foul breath, sweat and sebaceous secretions, gases from the alimentary canal, and decomposition of matter in the skin and clothing. Such odors are not known to be directly harmful to health, but they cause a sensation of "stuffiness" or oppressiveness. Under extreme conditions, headache, nausea, loss of appetite, and a disinclination for physical activity may result in sensitive persons breathing air containing these contaminants. The control of odors calls for the introduction into the room of enough fresh outdoor air to dilute the odoriferous matter to a concentration which is not objectionable.

In confined spaces, the dissemination of disease by the emission of pathogenic bacteria from infected persons is a possibilty. Droplets sprayed into the air during talking, coughing, and sneezing, do not all immediately fall to the ground a few feet from the source; minute droplets evaporate to dryness, and entrained bacteria may be dispersed through the room by air currents. However, it is generally recognized that the danger from air-borne infection, except in poorly ventilated rooms, is "much contracted in space, limited in time, and restricted to comparatively few diseases." Practical possibilities in sterilizing air supplies by the use of ultra-violet light have been the subject of research, with encouraging results.

Due to the concentration of industrial plants in cities and suburban areas, it is often difficult to obtain an outside air supply free from dust and dirt. In the recirculation of plant air this condition may be further augmented by dust-producing processes within the factory. The use of some form of air filter is a necessity for the removal of dust and dirt from almost any properly air-conditioned atmosphere. Air filters may be either of the dry or viscous type. In dry filters the air is filtered through screens made of felt, cloth, or cellulose, the dust being removed by the straining action of these materials. In the viscous type of filter, materials such as glass wool or steel wool are coated with a suitable viscous material to which the dust adheres as the air passes through the filtering media. Both of these filters are efficient in removing fine particles of soot or carbon, a material which is becoming increasingly common in the atmospheres of industrial centers.

In the absence of any specific contaminating substance, which must be controlled either at its source, by filtering, or by dilution, the three primary factors in air conditioning work are temperature, humidity, and air movement. They must be regulated simultaneously, since each is dependent, within certain limits, on the other two. As compared with these physical factors, the chemical factors are generally of secondary importance.

The importance of the thermal factors lies in their influence on body temperature, comfort, and health. High temperatures adversely affect the stomach, heart, lungs, and other vital organs, producing lassitude and discomfort. Loss of appetite, indigestion, headache, and general enervation may result in some persons. The deleterious physiologic effects of high temperatures have been shown to have a direct relation to physical activity, accidents, sickness, and mortality. Laboratory tests and field studies show that production falls progressively as temperature rises. The incidence of industrial accidents reaches a minimum at about 68° F., increasing above and below this temperature. Sickness and mortality rates increase progressively as the temperature rises above an effective temperature of between 80° and 90°. The action of cold on human beings is not well understood. The ill effects from cold seem to be due to sudden chilling and variations in temperature, rather than to cold alone.

Sensations of warmth or cold depend not only on the dry-bulb temperature of the surrounding air, but on the moisture content as indicated by a wet-bulb thermometer and on the air motion. Dry air at relatively high temperature may feel cooler than air of lower temperature with a high moisture content. If the humidity is high, the loss of moisture from the skin by evaporation is retarded, resulting in damp skin and clothing, and producing more or less discomfort. If the air is excessively dry, it produces chapped skin and drying of the mucous membranes of the nose and throat. From the standpoint of health, a relative humidity ranging between 40 and 60 per cent is desirable. Air motion makes any moderate air temperature feel cooler. The higher the air velocity, the cooler is the effective temperature unless the temperature of the air is above body temperature, in which case the reverse is true.

Combinations of temperature, humidity, and air movement which induce the same feeling of warmth, are called thermo-equivalent conditions. By experiments an index of subjective sensations of warmth produced by various thermo-equivalent conditions, known as the "effective temperature" scale, has been determined. The numerical value of the effective temperature index for any given air condition corresponds to the temperature of relatively calm (15 to 25 f.p.m. air movement) saturated air which induces a sensation of warmth or cold similar to that of the given condition. An effective temperature ranging between 63° and 71° E. T. is considered the comfort zone for the average individual. An understanding of effective temperature is especially valuable in industrial workroom air conditioning. For example, many industrial processes are such that they must be carried on under a constant humidity or constant temperature, in which case a knowledge of effective temperature index will serve as a guide in regulating the other two factors so as to maintain the apparent comfort sensation at an optimum value.

Although the principles involved in air conditioning are not new, it is only in recent years that scientific control of workroom, public building, and home atmospheres has become general rather than exceptional practice. It is important that public health workers cooperate with manufacturers and users of air conditioning equipment in order to further the extension of the beneficial effects on health and comfort of properly regulated, enclosed atmospheres to the general public as well as to industrial employees.

MEASLES RECORD BROKEN

During the first three months of this year, 40,880 cases of measles were reported in California. During the first three months of 1927, when measles was epidemic, 36,480 cases were reported during the first three months of the year. Heretofore, the 1927 outbreak was the most extensive in the history of the state. In that year there were 58,963 cases reported. It would appear that during the present year this number of cases will be exceeded.

GENERAL HEALTH CONDITIONS GOOD

Mumps is reported in epidemic proportions, together with measles. Typhoid fever is conspicuously low as only five cases were reported in the entire state during March. The incidence of other reportable diseases indicates normal conditions in the incidence of communicable diseases throughout California.

MATERNAL MORTALITY RATE LOWERED

In accordance with the decrease in the total deaths and in infant deaths during 1938, maternal deaths have also decreased. In 1937 there were 392 maternal deaths registered with a rate of 4.1 per 1000 live births, while in 1938 the number fell to 341 and a rate of 3.3 maternal deaths per 1000 live births. Segregated by racial groups, whites numbered 257 or 75.4 per cent, Negroes 15 or 4.4 per cent, Indians 2 or 0.6 per cent, Chinese 2 or 0.6 per cent, Japanese 6 or 1.8 per cent, Mexicans 57 or 16.7 per cent, Filipinos and other races each 1 or 0.3 per cent.

The segregation by age groups shows that there were 110 maternal deaths between the ages of 15 and 24; 142 such deaths between 25 and 34, 85 between 35 and 44 and 4 between 45 and 54. Of these deaths 83 of the mothers were born in California, 192 in other parts of the United States, 61 in foreign countries, 4 in U. S. possessions and 1 whose birthplace was unknown.

MATERNAL MORTALITY, 1938-1937

	1938		*1937*	
By Counties	*No.*	*Rate*	*No.*	*Rate*
Totals	341	3.3	392	4.1
Alameda	29	4.0	23	3.3
Alpine	--	--	--	--
Amador	--	--	--	--
Butte	3	3.4	6	8.5
Calaveras	--	--	--	--
Colusa	2	11.1	1	6.1
Contra Costa	5	4.3	6	5.4
Del Norte	--	--	1	14.1
El Dorado	--	--	--	--
Fresno	17	5.2	17	5.9
Glenn	--	--	1	6.3
Humboldt	3	4.0	10	14.2
Imperial	7	4.5	6	4.2
Inyo	--	--	--	--
Kern	11	3.8	9	3.6
Kings	1	1.4	4	6.0
Lake	--	--	--	--
Lassen	1	3.1	3	9.4
Los Angeles	123	3.2	127	3.5
Madera	4	7.6	2	4.1
Marin	--	--	3	8.4
Mariposa	--	--	1	33.3
Mendocino	2	5.2	3	8.3
Merced	1	1.0	4	4.7
Modoc	--	--	4	43.9
Mono	--	--	--	--
Monterey	5	4.4	3	2.9
Napa	1	3.0	--	--
Nevada	--	--	3	10.5
Orange	5	2.3	5	2.4
Placer	--	--	3	10.1
Plumas	--	--	--	--
Riverside	6	3.0	5	2.8
Sacramento	7	2.6	6	2.4
San Benito	--	--	--	--
San Bernardino	9	3.1	16	6.0
San Diego	18	3.9	14	3.3
San Francisco	19	2.2	33	4.0
San Joaquin	6	3.0	8	4.3
San Luis Obispo	--	--	--	--
San Mateo	2	2.5	3	4.6
Santa Barbara	5	4.0	5	4.4
Santa Clara	16	6.3	12	5.0
Santa Cruz	2	3.3	5	8.6
Shasta	--	--	--	--
Sierra	--	--	--	--
Siskiyou	3	6.9	3	7.8
Solano	--	--	4	8.5
Sonoma	3	3.3	5	6.7
Stanislaus	5	3.7	6	4.7
Sutter	2	5.4	2	6.9
Tehama	--	--	1	3.7
Trinity	--	--	--	--
Tulare	10	4.4	6	3.2
Tuolumne	1	5.6	1	7.0
Ventura	4	2.9	8	6.8
Yolo	3	7.8	2	5.8
Yuba	--	--	2	8.1

SMALLPOX PREVALENT

At the request of local health officers, smallpox cases were investigated during March, in San Bernardino, Santa Barbara, Contra Costa, San Luis Obispo, San Benito, Tulare, and Sacramento counties. The numbers of cases involved were not large but it would appear that mild, unrecognized cases have occurred in various districts of the state and unvaccinated contacts have contracted the disease. In some of these communities smallpox had appeared for the first time in many years. In one city, the disease gained a foothold in a single locality, and in spite of offers of vaccination, a few unvaccinated individuals continue to contract the disease. Two deaths from smallpox have occurred there during the past month.

MORBIDITY

Complete Reports for Following Diseases for Week Ending April 15, 1939

Chickenpox

1002 cases: Alameda County 4, Alameda 5, Berkeley 19, Livermore 3, Oakland 60, Piedmont 3, Chico 5, Angels Camp 1, Contra Costa County 3, Antioch 6, Concord 2, Pittsburg 2, Fresno County 10, Fresno 17, Glenn County 2, Imperial 2, Inyo County 13, Kern County 23, Bakersfield 6, Taft 2, Tehachapi 1, Kings County 1, Susanville 1, Los Angeles County 61, Alhambra 3, Claremont 4, Compton 4, Glendale 14, Glendora 1, Huntington Park 13, Long Beach 28, Los Angeles 155, Monrovia 3, Pasadena 17, San Gabriel 5, Santa Monica 12, South Gate 5, Monterey Park 1, Maywood 1, Bell 2, Madera County 8, Chowchilla 1, Sausalito 3, Mariposa County 3, Ukiah 1, Gustine 1, Merced 5, Salinas 2, Napa County 1, Orange County 15, Anaheim 2, Brea 1, Fullerton 1, Huntington Beach 1, Newport Beach 1, Orange 7, Santa Ana 2, Riverside County 5, Riverside 1, Sacramento County 3, Sacramento 30, San Bernardino County 5, San Bernardino 1, San Diego County 53, La Mesa 6, National City 18, Oceanside 9, San Diego 75, San Francisco 61, San Joaquin County 34, Lodi 2, Stockton 31, San Luis Obispo County 7, Paso Robles 3, San Mateo County 1, Burlingame 3, Daly City 7, San Bruno 1, San Mateo 1, Lawndale 1, Santa Barbara 2, Santa Maria 7, Santa Clara County 3, Mountain View 1, San Jose 11, Santa Cruz County 3, Shasta County 1, Solano County 2, Vallejo 1, Sonoma County 1, Petaluma 2, Modesto 1, Oakdale 1, Yuba City 1, Red Bluff 6, Tulare County 14, Exeter 1, Porterville 2, Tulare 2, Fillmore 1, Santa Paula 1, Yolo County 5.

Diphtheria

23 cases: Oakland 2, Compton 1, Los Angeles 8, Ukiah 6, Anaheim 1, Fullerton 1, Santa Ana 1, Santa Clara County 1, San Jose 1, Tulare County 1.

German Measles

48 cases: Alameda County 1, Berkeley 3, Oakland 3, San Leandro 1, Fresno 2, Susanville 3, Los Angeles County 3, El Monte 1, Long Beach 7, Los Angeles 5, Monterey Park 1, Signal Hill 1, Merced 1, Salinas 1, Orange County 2, Plumas County 1, San Diego County 1, San Francisco 2, San Joaquin County 2, Santa Maria 1, Solano County 1, Visalia 5.

Influenza

146 cases: Berkeley 15, Oakland 2, Fresno County 28, Inyo County 1, Kern County 8, Taft 1, Los Angeles County 8, Long

Beach 1, Los Angeles 30, Manhattan 1, Gardena 1, Madera County 2, Sausalito 1, Monterey County 1, Monterey 1, Salinas 2, Santa Ana 1, Plumas County 3, San Diego 3, San Francisco 10, Stockton 1, Arroyo Grande 1, San Mateo County 1, Santa Clara County 5, Sonoma County 1, Corning 1, Tulare County 3, Visalia 12, California 1.*

Malaria

6 cases: Oakland 1, Brawley 1, Yolo County 1, Yuba County 3.

Measles

3761 cases: Alameda County 85, Alameda 53, Albany 10, Berkeley 223, Hayward 2, Oakland 181, Piedmont 40, San Leandro 11, Colusa County 1, Contra Costa County 43, Antioch 3, Concord 3, El Cerrito 3, Martinez 42, Pinole 27, Pittsburg 5, Del Norte County 4, El Dorado County 1, Fresno County 48, Fresno 11, Reedley 1, Sanger 2, Glenn County 1, Humboldt County 23, Inyo County 39, Bishop 1, Kern County 5, Bakersfield 1, Hanford 2, Lake County 118, Susanville 15, Los Angeles County 182, Alhambra 7, Arcadia 2, Avalon 1, Beverly Hills 1, Burbank 5, Claremont 2, Compton 17, Culver City 10, El Monte 7, El Segundo 1, Glendale 35, Glendora 1, Hermosa 3, Huntington Park 9, Inglewood 3, La Verne 6, Long Beach 128, Los Angeles 677, Monrovia 2, Pasadena 18, Pomona 18, Redondo 12, San Fernando 1, San Gabriel 3, San Marino 4, Santa Monica 31, South Pasadena 13, Vernon 1, Torrance 7, Lynwood 5, Hawthorne 1, South Gate 21, Monterey Park 9, Signal Hill 4, Maywood 2, Bell 1, Gardena 3, Madera County 2, Chowchilla 1, Marin County 5, Mill Valley 9, San Rafael 11, Sausalito 1, Mariposa County 1, Yosemite National Park 1, Ukiah 27, Merced County 2, Gustine 20, Merced 8, Mono County 4, Monterey County 46, King City 4, Salinas 10, Napa County 7, Orange County 25, Anaheim 5, Fullerton 22, Huntington Beach 21, Newport Beach 2, Orange 1, Santa Ana 3, Seal Beach 1, La Habra 6, Laguna Beach 1, Plumas County 16, Riverside County 36, Banning 1, Beaumont 17, Hemet 1, Riverside 46, Indio 15, Palm Springs 4, Sacramento County 15, Sacramento 243, Hollister 1, San Bernardino County 86, Ontario 1, Redlands 1, San Bernardino 10, San Diego County 1, La Mesa 3, National City 2, San Diego 94, San Francisco 95, San Joaquin County 63, Lodi 12, Stockton 51, Tracy 1, San Luis Obispo County 23, Paso Robles 24, San Luis Obispo 2, San Mateo County 16, Burlingame 9, Daly City 1, Hillsborough 1, Redwood City 2, San Mateo 9, Atherton 3, Menlo Park 15, Santa Barbara County 4, Lompoc 1, Santa Barbara 1, Santa Maria 1, Santa Clara County 27, Gilroy 1, Los Gatos 4, Mountain View 3, Palo Alto 14, San Jose 34, Sunnyvale 39, Watsonville 15, Shasta County 9, Solano County 24, Benicia 40, Dixon 1, Vallejo 5, Sonoma County 31, Petaluma 11, Stanislaus County 15, Modesto 23, Oakdale 1, Yuba City 1, Tulare County 7, Porterville 4, Tulare 2, Tuolumne County 2, Yolo County 17, Marysville 1.

Mumps

953 cases: Alameda County 17, Alameda 1, Albany 2, Berkeley 65, Oakland 76, Piedmont 15, Pleasanton 5, San Leandro 3, Contra Costa County 28, Antioch 7, El Cerrito 1, Martinez 12, Pittsburg 2, El Dorado County 1, Placerville 1, Fresno County 11, Fresno 14, Glenn County 5, Kern County 67, Bakersfield 5, Kings County 16, Susanville 1, Los Angeles County 7, Alhambra 2, Glendale 3, Long Beach 10, Los Angeles 65, Monrovia 1, Pasadena 23, Pomona 2, San Marino 2, South Pasadena 1, Lynwood 2, South Gate 1, Bell 1, Madera County 6, Marin County 1, Mill Valley 3, San Rafael 2, Mariposa County 1, Yosemite National Park 5, Willits 4, Merced County 10, Gustine 2, Merced 11, Atwater 1, Monterey County 1, Napa County 1, Orange County 6, Santa Ana 2, Plumas County 3, Riverside County 9, Banning 1, Beaumont 2, Riverside 7, Sacramento 62, Hollister 1, San Bernardino County 13, Redlands 1, San Diego 15, San Francisco 56, San Joaquin County 67, Stockton 47, San Luis Obispo County 7, San Luis Obispo 9, San Mateo County 6, Burlingame 2, San Mateo 1, Santa Barbara 1, Santa Clara County 2, San Jose 4, Santa Clara 4, Santa Cruz County 1, Shasta County 2, Solano County 23, Benicia 10, Vallejo 1, Sonoma County 2, Stanislaus County 7, Modesto 6, Tehama County 2, Corning 8, Trinity County 2, Tulare County 7, Exeter 1, Porterville 4, Visalia 10, Tuolumne County 1, Yolo County 8, Woodland 5, Yuba County 2.

Pneumonia (Lobar)

73 cases: Alameda County 1, Hayward 1, Oakland 2, San Leandro 2, Coalinga 1, Kern County 1, Kings County 1, Susanville 1, Los Angeles County 5, Compton 1, Glendale 1, Los Angeles 34, Monrovia 1, Pasadena 1, Mill Valley 1, Merced 1, Monterey County 2, Orange County 2, Santa Ana 1, Riverside 1, Sacramento County 1, San Bernardino County 1, San Francisco 6, San Mateo County 1, Santa Barbara County 1, Watsonville 1, Tulare County 1.

Scarlet Fever

204 cases: Alameda 1, Berkeley 1, Oakland 4, Pleasanton 1, Colusa County 1, Contra Costa County 1, Martinez 1, Fresno County 9, Fresno 2, Sanger 1, Imperial County 1, Calexico 1, Kern County 2, Bakersfield 1, Kings County 3, Los Angeles County 15, Burbank 1, El Segundo 1, Glendale 1, Long Beach 6, Los Angeles 46, Pasadena 3, Pomona 4, San Fernando 1, San Gabriel 1, Santa Monica 1, Lynwood 1, Gardena 1, Madera County 4, Mariposa County 1, Merced County 2, Monterey County 5, Orange County 5, Santa Ana 2, Laguna Beach 1, Plumas County 3, Riverside County 1, Blythe 3, Perris 1, Riverside 2, Sacramento 2, San Bernardino County 4, Redlands 1, San Diego 3, San Francisco 21, Lodi 1, Stockton 3, San Mateo County 1, Redwood City 1, San Mateo 1, Santa Barbara County 1, Santa Barbara 3, Santa Clara County 4, San Jose 1, Santa Cruz County 1, Sonoma County 2, Healdsburg 1, Stanislaus County 2, Turlock 2, Sutter County 1, Yuba City 1, Tulare County 3, Porterville 1, Yuba County 1.

Smallpox

32 cases: Fresno County 4, Calipatria 1, Hanford 1, Los Angeles 1, Mariposa County 2, Riverside County 4, Sacramento County 1, Sacramento 1, San Benito County 1, Hollister 4, San Bernardino County 1, National City 2, Santa Clara County 4, Tulare County 1, Porterville 3, Yuba County 1.

Typhoid Fever

4 cases: Calaveras County 1, Laguna Beach 1, Santa Barbara County 1, Stanislaus County 1.

Whooping Cough

211 cases: Alameda County 1, Albany 1, Berkeley 4, Pittsburg 1, Calipatria 3, Inyo County 2, Kern County 14, Bakersfield 4, Susanville 6, Los Angeles County 8, Alhambra 1, Glendale 3, Huntington Park 3, Inglewood 2, Long Beach 16, Los Angeles 19, Monrovia 1, Pomona 1, Redondo 1, South Pasadena 2, Napa County 1, Grass Valley 1, Anaheim 1, Fullerton 9, Santa Ana 8, Riverside County 4, Indio 1, San Bernardino County 19, San Bernardino 1, San Diego 18, San Francisco 11, San Joaquin County 4, San Luis Obispo 1, San Mateo 1, Daly City 4, Santa Barbara County 2, Lompoc 1, Santa Barbara 7, San Jose 1, Sonoma County 1, Petaluma 2, Sutter County 1, Porterville 1, Ventura County 1, Oxnard 1, Yolo County 5, Winters 11.

Meningitis (Epidemic)

3 cases: Oakland 1, Los Angeles 1, San Francisco 1.

Dysentery (Amoebic)

3 cases: Fresno 1, Indio 1, Stanislaus County 1.

Dysentery (Bacillary)

6 cases: Azusa 1, Los Angeles 2, San Diego County 1, San Francisco 1, Sonoma County 1.

Pellagra

2 cases: Fresno County 1, Los Angeles 1.

Poliomyelitis

3 cases: Fresno County 1, Los Angeles 1, Siskiyou County 1.

Tetanus

One case: San Bernardino.

Trachoma

3 cases: Los Angeles County 1, Beaumont 1, Indio 1.

Encephalitis (Epidemic)

2 cases: Fresno County 1, Fullerton 1.

Rocky Mountain Spotted Fever

2 cases: Alturas.

Jaundice (Epidemic)

6 cases: Salinas 1, Santa Cruz County 1, Sonoma County 4.

Food Poisoning

5 cases: San Francisco 2, Stockton 3.

Undulant Fever

3 cases: Chico 1, Alhambra 1, Monrovia 1.

Coccidioidal Granuloma

One case: Los Angeles.

Septic Sore Throat

7 cases: Los Angeles County 1, Pomona 1, San Bernardino County 5.

Rabies (Animal)

41 cases: Berkeley 1, Calaveras County 1, Fresno County 1, Bakersfield 2, Kings County 1, Hanford 2, Los Angeles County 2, Los Angeles 4, Maywood 1, Pacific Grove 2, San Diego 1, Santa Clara County 17, Santa Clara 3, Sunnyvale 2, Santa Paula 1.

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* Cases charged to "California" represent patients ill before entering the state or those who contracted their illness traveling about the state throughout the incubation period of the disease. These cases are not chargeable to any one locality.

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